NASA Procedural Requirements

NPR 1800.1D
Effective Date: May 13, 2016
Expiration Date: May 13, 2021

COMPLIANCE IS MANDATORY

Printable Format (PDF)

Request Notification of Change (NASA Only)

Subject: NASA Occupational Health Program Procedure

Responsible Office: Office of the Chief Health & Medical Officer

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Chapter 4 Environmental Health

4.1 General

4.1.1 Program

4.1.1.1 Chapter 4 contains requirements additional to Federal regulatory requirements (e.g., OSHA, NRC, Food and Drug Administration (FDA), Department of Defense (DOD), and Department of Energy (DOE), although some could be enforced under the OSHA general duty clause. The NPR is not meant to replace or repeat those regulatory requirements.

4.1.1.2 In addition to legal requirements, Centers shall comply with applicable consensus standards and proprietary standards (i.e., American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents; American National Standard Institute (ANSI); the Society of Automotive Engineers (SAE)).

4.1.1.3 Center EH organizations shall have a direct line of authority to the Center Director, such that other organizations that have conflicting interests in EH decisions are not in the path of authority.

4.1.2 Responsibilities

4.1.2.1 The OCHMO shall establish policy requirements for the EH programs. The OCHMO does not directly oversee day-to-day operations or programs at NASA Centers or other NASA institutions.

4.1.2.2 The Director Health and Medical Systems shall ensure the Center EH policies and programs are assessed for efficacy through regular, periodic reviews.

4.1.3 Recordkeeping

4.1.3.1 Centers shall keep records to evaluate trends and outcomes; validate the effectiveness of EH programs, document training and pertinent EH events, and provide a mechanism for active managerial control over EH programs. These records will be managed in accordance with NPR 1441.1, NASA Records Management Program Requirements.

4.1.3.2 Records shall be complete, accurate, and timely, appropriate for the task, and provide for a continuity of information.

4.1.3.3 Records shall be historically traceable.

4.1.3.4 EH and related records shall be subject to periodic review for quality efficacy and consistency by the OCHMO.

4.1.3.5 Centers shall generate, retain, and dispose of EH records according to NASA records requirements as outline in Section P1d and 1.11 of this NPR.

4.1.3.6 The Agency EHRS IH module shall be used to the maximum extent possible for OCHMO-defined IH

requirements, including exposure characterizations, records retention (e.g., ergonomics evaluation, exposure or incident investigations, Indoor Air Quality (IAQ) surveys, and EH instrumentation inventory records).

4.1.4 Center Policies and Procedures

4.1.4.1 Centers shall have all the appropriate Center-level policy level documents, as required by EH applicable regulations and this NPR.

4.1.4.2 Centers shall develop and maintain procedural level documentation to adequately and consistently implement their programs.

4.1.5 Emergency Preparedness

4.1.5.1 The OCHMO shall provide guidance and advice to NASA Centers on EH emergency preparedness.

4.1.5.2 The Director of Health and Medical Systems shall ensure Center EH emergency preparedness policy and programs are assessed for efficacy through regular, periodic reviews.

4.1.5.3 EH organizations shall develop emergency management plans to implement their roles and responsibilities as specified in their respective Center Emergency Management Plans.

4.1.5.4 Center EH organizations shall participate, at least annually, in Center emergency drills and lessons learned.

4.1.5.5 EH organizations shall use lessons learned to improve EH emergency responses.

4.1.6 Notification Requirements.

4.1.6.1 In addition to the reporting requirements specified elsewhere in this NPR, Centers shall inform the DASHO or Director of Health and Medical Systems, and the Senior Environmental Health Officer (SEHO), by the most expeditious means, of the following Center events:

a. Work-related death or in-patient hospitalization;

b. Official visits by any Federal, state, or local safety or EH regulatory agency;

c. Refusal of entry of any Federal, state, or local safety or EH regulatory agency;

d. Receipt of Federal, state, or local safety or EH regulatory citations;

e. Health and safety-related reports of reprisal or discrimination;

f. Reports of Immediately Dangerous to Life and Health (IDLH) working conditions;

g. Health and safety-related warrants/subpoenas; and

h. Other EH-related contact with any Federal or state agency or organization involving regulatory issues or agency-related agreements.

4.1.6.2 Centers shall inform the DASHO and OSMA, within 10 days, of the results of OSHA inspections and investigative reports of OSHA reportable events.

4.1.6.3 Centers shall inform the DASHO and OSMA, within 10 days, of corrective action reports or OSHA reportable events, replies to OSHA inspections, and reports of unsafe working conditions that are unresolved in 30 days.

4.1.6.4 Centers shall inform the SEHO of any and all coordination, partnering, collaboration, and other such agreements with Federal agencies within 10 days of first contact.

4.1.7 Training and Certification

4.1.7.1 All workers shall be effectively and adequately trained for the tasks they perform and shall meet at least the minimum applicable regulatory requirements for training and certification.

4.1.7.2 The requirements of OSHA Publication, OSHA 2254, Training Requirements in OSHA Standards, and Training Guidelines shall be met.

4.1.7.3 In addition to the safety training requirements required in 29 CFR 1960, 29 CFR 1910, and 29 CFR 1926, safety and health inspectors, managers, supervisors, safety and health specialists, safety and health committee members, and employees shall meet the requirements of NPR 8715.1, NASA Occupational Safety and Health Programs.

4.1.8 EH Budget and Resources

4.1.8.1 The NASA Administrator shall ensure that the Agency budget submission includes appropriate financial and other resources to effectively implement and administer the Agency's EH program per 29 CFR 1960.7, Financial Management.

4.1.8.2 The DASHO, Center Directors, Senior Center Managers, enterprise Program Managers, and OH CORs shall be responsible for planning, requesting resources, implementing, and evaluating EH program budgets in accordance with 29 CFR 1960.7(b), OMB Circular A-11 (sections 13.2(f) and 13.5(f), and other relevant documents).

4.1.8.3 The OCHMO shall provide guidance and advice to NASA Centers on the EH budget and resources.

4.1.8.4 The Director of Health and Medical Systems shall ensure Center EH budget and resources are assessed for efficacy through regular, periodic reviews.

4.1.8.5 Resources for EH programs shall include, but not be limited to, the following:

a. Sufficient personnel to implement and administer the program at all levels, including necessary administrative costs such as training, travel, and PPE;

b. Abatement of unsafe or unhealthful working conditions related to Agency operations or infrastructure;

c. Safety and health sampling, testing, and diagnostic and analytical tools and equipment, including laboratory analyses;

d. Capability to identify, analyze, and evaluate unsafe and unhealthful working conditions and operations;

e. Educational promotional costs such as publications, posters, or films;

f. Technical information, documents, books, standards, codes, periodicals, and publications;

g. Medical surveillance programs for personnel; and

h. Personnel, equipment, and other resources needed in support of the Agency Electronic Health Record System Industrial Hygiene module.

4.2 Occupational Exposure Limits (OEL's)

4.2.1 General

4.2.1.1 Unless specified elsewhere in this chapter, NASA Centers shall utilize OSHA Permissible Exposure Limits (PEL's), Threshold Limit Values (TLV's) issued by the American Conference of Governmental Industrial Hygienists (ACGIH) or specific NASA Health Standards issued by the OCHMO, whichever is more protective or whichever is selected by a competent person (See Appendix A).

> *Note: While the OSHA PEL's carry the weight of law, the majority of these regulations were adopted in 1970 from 1968 consensus values and most often do not reflect current scientific data. Additionally, there are currently only PEL's established for approximately 400 chemicals, which is a relatively small percentage of the thousands of chemicals that exist. For these reasons, NASA adopts the use of OEL's as a necessary and prudent practice.*

4.2.2 Responsibilities

4.2.2.1 The OCHMO shall provide guidance and advice to NASA Centers on OELs.

4.2.2.2 The Director of Health and Medical Systems shall ensure Center OEL policy and programs are assessed for efficacy through regular, periodic reviews.

4.2.2.3 At a minimum, Centers shall follow the OEL's required by law, recommended and established by acknowledged authorities, and those developed specifically by NASA and shall apply whichever is more protective in the judgment of a competent person, such as a Certified Industrial Hygienist (CIH).

4.2.2.4 Centers shall be responsible for monitoring the workplace and workforce, selecting the most appropriate and protective OEL's for the work being performed, and ensuring people with appropriate training implement OEL's.

4.2.2.5 Centers shall be responsible for developing OEL's in the absence of an existing OEL for a specific chemical.

4.2.3 Process Description

4.2.3.1 In the absence of a specific PEL, TLV, or NASA Standard, other sources of OEL's shall be utilized. These include the following: (1) The National Institute for Occupational Safety & Health's (NIOSH) Recommended Exposure Limits (REL's); (2) The American National Standards Institute (ANSI) Standards; (3) The National Academy of Science Recommendations; (4) The American Industrial Hygiene Association (AIHA) Workplace Environmental Exposure Levels (WEELs); (5) The Environmental Protection Agency (EPA) Recommendations; (6) The Deutsche Forschungsgemeinschaft (German Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area) Maximum Allowable Concentrations; (7) The British Health & Safety Commission and Health & Safety Executive Occupational Exposure Limits and (8) Chemical manufacturers' recommended exposure values.

> *NOTE: When no established OEL exists for a specific chemical, a working OEL should be established by a*

competent person based on a thorough examination of the data available for that chemical and by following established industrial hygiene exposure limit setting guidelines. The process of establishing a working OEL should take into account chemical analogy, animal experimentation and extrapolation, and human experience and epidemiological data. In lieu of establishing a working OEL, Centers may take the approach of using control banding until an OEL is set by one of the organizations listed above. If Centers need assistance in determining OEL's, the Agency will pursue individual requests with the appropriate Federal agency or standard-setting organization.

4.2.3.2 Document the rationale used in establishing an OEL. The rationale should consider, summarize, and weigh the importance of all data. Additionally, experience and professional judgment shall be applied to weigh all information and apply an appropriate safety factor, based on the strength of the available data, before an OEL is established.

4.2.3.3 All of the available data used to establish the OEL shall be thoroughly documented.

4.2.3.4 Centers shall notify the OCHMO of all newly established OELs.

4.3 Occupational Exposure Assessment and Management

4.3.1 General

4.3.1.1 NASA Centers shall use a systematic and comprehensive approach to exposure assessment to anticipate, recognize, evaluate, and control health hazards in the workplace to effectively and proactively manage all EH programs.

4.3.2 Responsibilities

4.3.2.1 The OCHMO shall provide guidance and advice to NASA Centers on occupational exposure assessment and management.

4.3.2.2 The Director of Health and Medical Systems shall ensure Center occupational exposure assessment and management policy and programs are assessed for efficacy through regular, periodic reviews.

4.3.2.3 Centers shall employ a systematic and comprehensive approach to exposure assessment, establishing and implementing effective exposure assessment and management programs to anticipate, recognize, evaluate, and control health hazards in the workplace.

4.3.3 Process Description

4.3.3.1 EH programs shall establish a written Occupational Exposure Assessment and Management Program whose purpose is to collect and organize available information on the workplace; the workforce; chemical, physical, and biological agents; existing exposure controls; historical exposure data; biological monitoring data; and any other available source of information such as OEL's.

4.3.3.2 The written program shall include program goals and objectives and shall include an initial comprehensive exposure assessment, which shall be maintained current.

4.3.3.3 The outcome of this exposure assessment effort shall be a complete summary of available, essential information on workers, tasks, chemical, physical and biological agents, potential exposures (factoring in frequency and duration) and potential health effects.

4.3.3.4 Center EH programs shall create similar exposure groups (SEG's) and define exposure profiles for all identified exposure groups. The exception to this requirement would be research and test operations, which do not lend themselves to having similar exposures.

4.3.3.5 A determination shall be made about the acceptability, unacceptability, or uncertainty of the exposure profile defined for each SEG. Uncertain exposures shall lead to further information gathering. Unacceptable exposures shall lead to control of the exposure. Acceptable exposures shall lead to a periodic programmed reassessment based on risk.

4.3.3.6 Exposure groups with unacceptable exposures shall be prioritized and a strategy developed for exposure control.

4.3.3.7 OM clinics shall be notified regarding action level and unacceptable exposures for medical surveillance purposes and to identify SEGs.

4.3.3.8 Exposure assessment programs shall have a component that involves continual information gathering for the purpose of setting priorities on exposure groups for additional characterization and further information gathering. This can be either qualitative or quantitative information and shall be used to enhance the basic characterization and better define exposure groups, their profile, and the risks posed by exposure profiles.

4.3.3.9 Engineering controls shall be applied first. Until engineering controls are implemented or when engineering controls are not feasible, administrative controls or PPE shall be used. PPE shall be used as a last control measure.

4.3.3.10 Exposures shall be periodically re-characterized and reassessed in order to update exposure groups and exposure profiles.

4.3.3.11 The following records shall be maintained in accordance with NASA's record requirements and this NPR:

a. Lists of SEG's;

b. Exposure profiles; and

c. Judgments of acceptability.

4.4 Sampling, Analytical Methods, and Equipment Calibration

4.4.1 General

4.4.1.1 The integrity of critical data shall be ensured by adherence to OSHA, NIOSH, or other recognized sampling and analytical methods using properly calibrated equipment with the National Institute of Standards and Technology (NIST) traceability, where applicable.

4.4.2 Responsibilities

4.4.2.1 The OCHMO shall provide guidance and advice to NASA Centers on sampling, analytical methods, and equipment calibration.

4.4.2.2 The Director of Health and Medical Systems shall ensure Center sampling, analytical methods, and equipment calibration policy and programs are assessed for efficacy through regular, periodic reviews.

4.4.2.3 Centers shall develop policies and procedures to ensure that proper sampling techniques, analytical methods, and equipment calibration are used throughout the data collection process.

4.4.2.4 Centers shall ensure adherence to OSHA, NIOSH, or other recognized sampling and analytical methods and use properly calibrated equipment with the NIST traceability, where applicable.

4.4.3 Process Description

4.4.3.1 Centers shall develop written policies and procedures for sampling, analytical methods, and equipment calibration utilizing methods established by professional or regulatory bodies. At a minimum, these requirements shall address sample planning, sampling methodology, pre-survey calibration, survey performance, sample collection, post-survey calibration, sample documentation, shipment of sample media, equipment calibration and maintenance, and recordkeeping.

4.4.3.2 Engineering, administrative, and PPE controls, in hierarchical order, shall be applied as appropriate whenever the sample exceeds the applicable OEL. Engineering controls shall be applied first. Until engineering controls are implemented or when engineering controls are not feasible, administrative controls or PPE shall be used. PPE shall be used as a last control measure.

4.4.3.3 Results shall be maintained in accordance with NASA recordkeeping requirements.

4.5 Reproductive and Developmental Health

4.5.1 General

4.5.1.1 NASA Centers shall protect the reproductive health of the workforce and others from exposures to hazardous materials and articles (chemical, biological, radiological, and physical) that are known or suspected of being capable of posing a hazard to human reproduction.

4.5.1.2 Potential reproductive and developmental hazards shall be identified, and appropriate exposure control measures shall be implemented.

4.5.1.3 Exposures shall be kept As Low as Reasonably Practicable (ALARP) since short-term exposures to reproductive hazards can result in long-term health effects, and a developing fetus may also be adversely affected by exposures lower than those generally considered safe for adults.

4.5.2 Responsibilities

4.5.2.1 The OCHMO shall provide guidance and advice to NASA Centers on reproductive and developmental health.

4.5.2.2 The Director of Health and Medical Systems shall ensure Center reproductive and developmental health

policy and programs are assessed for efficacy through regular, periodic reviews.

4.5.2.3 Centers shall develop, implement, administer, and maintain written Developmental and Reproductive Health Protection Programs that are designed to ensure the workforce and their unborn children are adequately protected from recognized hazards.

4.5.3 Process Description

4.5.3.1 Written developmental and reproductive health protection guidelines shall include provisions for:

a. Evaluating areas where potential chemical, biological, or physical reproductive hazards exist;

b. Determining the extent of potential exposures;

c. Developing/implementing procedures to reduce workplace exposures to reproductive hazards (i.e., engineering controls, job rotation, use of PPE, etc.);

d. Providing information and training on the chemical, physical, and biological hazards that may be present in the work area which may be reproductive and developmental health hazards;

e. Providing training on the proper use of PPE, safety devices, and other methods of decreasing exposure, including information on the declaration of pregnancy for radiological issues.

f. Implementing measures (for declared pregnancies) to achieve the lower exposure limit (0.5 rem to embryo/fetus during entire gestation period) and conducting dose monitoring;

g. Managing written declaration of pregnancies for workers exposed to radiological hazards.

NOTE: See sections entitled Radioactive Materials and Ionizing Radiation-Generation Equipment of this Chapter for more information.

h. Ensuring that known reproductive hazards specific to a work area are described in a written Job Safety Analysis (JSA), Job Hazard Analysis (JHA), or other hazard documentation.

i. Ensuring that supervisors provide individual operational training to assure reduced risk of exposures;

j. Maximizing worker privacy when implementing the elements of the program;

k. Notifying Center OM clinics of areas with potential exposures for medical surveillance purposes.

l. Notifying EH regarding new areas that may require workplace hazard assessment;

m. Ensuring that alternate job duties are considered when indicated by the OM clinic;

n. Designating the person responsible for arranging reasonable accommodations, if available; and

o. Designating the person responsible for counseling the affected person about other options, including sick leave and family leave when a reasonable accommodation is not available.

4.5.3.2 Center EH organizations shall perform additional workplace hazard assessments upon the request or when changes occur to ensure existing controls (engineering, administrative, and PPE) are adequate to protect workers from reproductive hazards.

4.5.3.3 The additional workplace hazard assessment shall include:

a. Identification of chemical, biological, physical, and radioactive agents in the workplace that present a potential exposure risk;

b. A qualitative exposure assessment of the concerned worker;

c. A review of work practices and PPE used, and recommendations for additional control measures, if needed; and

d. A review of past EH reports and historical sampling results, if available.

4.6 Nanotoxicology

4.6.1 General

4.6.1.1 Nanomaterial, as currently defined by NIOSH, may pose an unusual risk to human health due to their unique composition, reactivity, size, and ability to cross cell membranes. All work with manufactured nanomaterial shall be prudently conducted in a manner that is responsible and safe.

4.6.2 Responsibilities

4.6.2.1 The 4.6.2.1 OCHMO shall provide guidance and advice to NASA Centers on nanotechnology.

4.6.2.2 The Director of Health and Medical Systems shall ensure Center nanotechnology policy and programs are assessed for efficacy through regular, periodic reviews.

4.6.2.3 Centers shall ensure that all work with manufactured nanomaterial adheres to NASA's requirements as per 4.6.1.1 of this document.

4.6.2.4 Centers with nanomaterial shall have written nanotoxicology programs that are designed and implemented to ensure all work with manufactured nanomaterial minimizes exposures to an ALARP level, or to other exposure standards as described in this NPR.

4.6.3 Process Description

4.6.3.1 Center nanotoxicology programs shall encompass the requirements of this section.

4.6.3.2 Transportation, storage, use, and disposal of manufactured nanomaterial shall be conducted in accordance with all Federal, state, local, Agency, and Center requirements.

4.6.3.3 Workers potentially exposed to manufactured nanomaterials shall be informed of the risks associated through training programs, safety data sheets, labeling, and signage.

4.6.3.4 Centers shall conform to best available work practices, such as, but not limited to, those from NIOSH, OSHA, or FDA for products that utilize nanotechnology and/or contain manufactured nanomaterial.

4.6.3.5 Centers shall conduct Hazard Assessments (HA's) prior to beginning work with manufactured nanomaterial.

4.6.3.6 HA's shall be conducted by a competent person who shall identify appropriate engineering controls, administrative controls, and personal protective equipment to ensure worker safety.

> *NOTE: A competent person is a person who has acquired through training, qualification, and experience, the knowledge, skills, and professional judgment to identify hazardous materials and/or articles and who has the designated ability to manage those substances and/or articles that are brought onto the Center. This is generally an American Board of Industrial Hygiene (ABIH) CIH.*

4.6.3.7 HA's shall evaluate several factors, including, but not limited to, the physical and chemical properties of the nanomaterial, the process by which it will be generated and/or used, and the adequacy of existing engineering controls (e.g., fume hood, glove box).

> *NOTE: In some instances, the competent person may recommend collecting occupational exposure measurements (e.g., sampling) to further understand potential hazards or to identify specific processes or equipment requiring additional engineering controls.*

4.6.3.8 Exposures to manufactured nanomaterial shall be kept to a minimum ALARP by utilizing the basic hierarchy of controls described below, as prescribed by a competent person with the exception of a material being in solution or embedded in substrate where it cannot become airborne.

> *NOTE: Although traditional OEL's exist for many of the materials from which nanomaterial is made, the OEL for a nanomaterial of these substances is not yet clear. As a result, NASA approach for controlling exposures to nanomaterial differs from those of traditional hazardous materials covered in the section entitled Occupational Exposure Assessment and Management.*

a. Engineering. These controls may include local exhaust ventilation and localized filtration.

b. Administrative. It is important to incorporate administrative controls, such as scheduling maintenance of fume hoods on off hours, and limiting potential exposure time, into operations involving nanomaterial's due to the ambiguity about nanomaterial OELs. The incorporation of good work practices helps to minimize exposure to manufactured nanoparticles.

c. PPE. Typical chemistry laboratory apparel and PPE shall be worn when working with manufactured nanomaterial. This includes long pants, shirts, and shoes, as well as safety glasses, laboratory coats, gloves, and eye protection. If the nanomaterial can become airborne (not in solution or embedded in substrate), then respiratory protection is required. Open sandals, shorts, and skirts are prohibited. Respiratory protection shall be utilized when local exhaust ventilation and filtration are not available or feasible for work involving manufactured nanomaterial not suspended in liquids or embedded in substrate. However, the preferred method for manipulating manufactured nanomaterial is in solution, and every effort should be made to design and implement effective engineering controls for any operation where manufactured nanomaterial are used.

4.6.3.9 Spill management shall be addressed emphasizing that all debris resulting from the cleanup of a manufactured nanomaterial spill shall be handled as though it were hazardous and include procedures for access control and cleanup of both dry and wet materials.

4.7 Control of Hazardous Materials and Articles Acquisitions

4.7.1 General

4.7.1.1 NASA Centers shall evaluate the potential exposure issues involved with the use of hazardous materials and articles.

4.7.1.2 Hazardous materials and/or articles shall not be procured or otherwise acquired until hazards have been analyzed and adequate controls selected.

4.7.1.3 Hazardous materials and/or articles shall not be brought onto Centers until adequate controls have been implemented.

4.7.2 Responsibilities

4.7.2.1 The OCHMO shall provide guidance and advice to NASA Centers on hazardous materials and articles acquisitions.

4.7.2.2 The Director of Health and Medical Systems shall ensure Center hazardous materials and articles acquisition policy and programs are assessed for efficacy through regular, periodic reviews.

4.7.2.3 NASA Centers shall be responsible for:

a. Administering and identifying hazardous material and article acquisitions;

b. Maintaining and monitoring the effectiveness of hazardous material and/or article acquisition programs, including all mechanisms for acquiring hazardous materials and articles;

c. Reviewing the records of purchases, at least annually, to ensure that hazardous materials and/or articles acquisitions are being properly reviewed and approved by competent persons and occupational health safety requirements are being properly implemented prior to acquisition;

d. At a minimum, following the manufacturer's product recommendations and requirements, except when directed by a competent person to use alternate controls or where inconsistent with the requirements of Section 4.8 or generally accepted practices;

e. Monitoring conformance with the requirements and reporting nonconformances to Center or Facility Managers; and

f. Ensuring the requirements of this section are included in all contract procurements with provisions to extend the requirements into subcontracts.

4.7.2.4 Competent Persons shall review procurements and other acquisitions of hazardous materials and/or articles, and coordinate with Center occupational safety and health organizations to:

a. Identify hazards associated with the materials and/or articles being obtained;

b. Identify alternatives, where available, to reduce risk;

c. Determine safety and health requirements for the safe use of hazardous materials and/or articles; and

d. Disapprove acquisitions of hazardous materials and/or articles that cannot be safely used.

4.7.3 Process Description

4.7.3.1 Each Center shall implement a means to control and regulate acquisitions of hazardous materials and/or articles.

4.7.3.2 Each Center shall implement a means to hold purchasers and receivers accountable for the proper and safe acquisition of hazardous materials and articles.

4.7.3.3 The following requirements shall be implemented prior to hazardous materials and/or articles acquisition:

a. Use of less hazardous materials or articles, if materials and/or articles can reasonably be substituted;

b. Acquisition of the smallest reasonable amount, size, activity, and/or hazard potential;

c. Approval of the acquisition by an Competent Person; and

d. Completion of hazard determinations, training, and other pertinent preparations adequate to ensure safe use.

4.8 Hearing Conservation

4.8.1 General

4.8.1.1 NASA Centers shall protect and conserve the hearing of the workforce from occupational exposures to

hazardous noise by identifying hazardous noise areas and appropriately implementing noise exposure control measures.

4.8.1.2 Any work area where the environmental noise level is at or above 85 dB A-weighted (dBA), or where the environmental impulse noise level is at or above 140 dB peak C-weighted (dBC) or linear, regardless of duration of exposure or number of impulses, shall constitute a hazardous noise area.

4.8.1.3 This section outlines additional requirements to those established in 29 CFR 1910.95, Occupational Noise Exposure Hearing Conservation Amendment Final Rule and appendices and 29 CFR 1904.10, Occupational Injury and Illness Recordkeeping and Reporting Requirements for prevention of noise-induced hearing loss where workers are occupationally exposed to hazardous noise. It applies to all NASA occupational settings except space flight.

4.8.1.4 The implementation of a written site-specific Hearing Conservation Program (HCP) shall be the mandatory means by which Centers and other field facilities apply Federal, state, local and NASA Hearing Conservation standards and associated program requirements. In addition, Centers shall administer a continuing, effective HCP in conformance with the requirements of this section with all the affected workers included in the program.

4.8.1.5 Personnel knowledgeable in sound analysis, noise exposure assessment, hearing protection, audiometric testing, and noise abatement strategies shall implement HCP and associated programs.

4.8.1.6 Center's HCP self-reviews shall be documented and performed at least annually. A self-review shall consist of items such as, but not limited to, review of Standard Threshold Shift (STS), review of hazardous noise areas, and review of monitoring equipment.

4.8.1.7 Site-specific "Buy Quiet" and "Quiet by Design" programs shall be implemented to protect workers and assure that purchases and designs are best values (i.e., having lowest, long-term cost of exposure to noise produced by the purchase of equipment) and in NASA's best interest.

4.8.1.8 Workers exposed to noise equal to or exceeding the NASA action level of 82 dBA Time-weighted Average (TWA) for 30 days or more per year, or those who can be expected to be exposed to 85 dBA TWA for any one day, shall be enrolled in a HCP that meets the requirements of this NPR. Exposures shall be computed without regard to any attenuation provided by the use of personal protective equipment.

NOTE: NASA's Action Level for noise is the equivalent to an 82 dBA, 8-hour TWA exposure, using a 3 dB exchange rate, as shown in Table 1 Below.

NASA's Action Level Equivalent Exposures: Table 1

Level (dBA)	Hour	Minutes	Seconds
79	16	0	0
80	12	41	57
81	10	4	46
82	8	0	0
83	6	20	59
84	5	2	23
85	4	0	0
86	3	10	29
87	2	31	11
88	2	0	0
89	1	35	15
90	1	15	36
91	1	0	0
93	0	37	48
94	0	30	0
95	0	23	40

96	0	18	54
97	0	15	0
92	0	47	37

4.8.1.9 Workers who enter designated areas or who perform tasks where exposure to noise is greater than or equal to 82 dBA, regardless of the duration of exposure, shall be provided with personal Hearing Protection Devices (HPDs).

4.8.1.10 Workers who enter designated hazardous noise areas or who perform tasks where exposure to noise is greater than or equal to 85 dBA or 140 peak dBC or linear, regardless of the duration of exposure or number of impulses, shall be provided with and required to wear personal HPDs.

4.8.1.11 NASA's noise exposure limit (Criterion Sound Level) is the equivalent to an 85 dBA, 8-hour TWA exposure using a 3 dB exchange rate as shown in Table 2 below.

Noise Exposure Limits (Equivalent Exposures): Table 2

Level (dBA)	Hours	Minutes	Seconds
81	20	10	0
82	16	0	0
83	12	42	0
84	10	5	0
85	8	0	0
86	6	21	0
87	5	2	0
88	4	0	0
89	3	10	0
90	2	31	0
91	2	0	0
92	1	35	0
93	1	16	0
94	1	0	0
95	0	47	37
96	0	37	48
97	0	30	0
98	0	23	49
99	0	18	59
100	0	15	0

NOTE: Table 2 contains noise exposure levels and durations that are equivalent to this limit as calculated by the following formula where L stands for exposure level and T for duration: T (min) = 480/2 (L-85)/3. Noise dose shall include all impact/impulse noise measured up to and including 140 peak dBC or linear.

4.8.1.12 The definitions in 29 CFR 1910.95, Occupational Noise Exposure, Appendix I, are applicable to this section unless otherwise defined in Appendix A of this NPR.

4.8.1.13 Exposures exceeding the limits in Table 2 shall be controlled, reduced, or eliminated through a hierarchical combination of engineering controls, administrative controls, and hearing protection devices.

4.8.1.14 Engineering controls shall be the first and primary means of controlling hazardous noise.

4.8.2 Responsibilities

4.8.2.1 The OCHMO shall provide guidance and advice to NASA Centers on hearing conservation.

4.8.2.2 The Director of Health and Medical Systems shall ensure Center hearing conservation policy and programs are assessed for efficacy through regular, periodic reviews.

4.8.2.3 Centers shall implement written HCP Programs.

4.8.2.4 The Agency Chief Engineer and the Agency Assistant Administrator of Strategic Infrastructure shall ensure that "Buy Quiet and Quiet by Design" provisions are integral to site selection and the design of new or modified facilities and equipment.

4.8.2.5 The Agency Assistant Administrator for Procurement shall ensure that "Buy Quiet" and "Quiet by Design" provisions are included in contracts and in the purchase of new equipment that generates 80 dBA or greater at 3 feet.

4.8.2.6 Center Directors and the Assistant Administrator for Strategic Infrastructure shall ensure that adequate facility resources are provided to implement Center HCPs, Buy Quiet Programs, and Quiet by Design Programs.

4.8.2.7 Center Purchase Requesters/Requirements Initiators shall coordinate with Center OH offices to ensure requirements documents include provisions for written HCPs, Buy Quiet Programs, and Quiet by Design Programs.

4.8.2.8 Contracting Officers shall work with Center OH officers and Purchase Requesters/Requirements Initiators to ensure that Center contract requirements include provisions for written HCPs, Buy Quiet Programs, and Quiet by Design Programs.

4.8.2.9 Medical Directors shall ensure that medical examinations relative to occupational noise are properly performed, appropriate records are maintained, and that all examination results are communicated to the affected person as specified in this NPR.

4.8.3 Process Description

4.8.3.1 Center HCPs shall include provisions for:

a. Specifying the individual responsibilities of Facilities Managers, Design Engineers, Occupational Health Personnel, Supervisors, and affected workers;

b. Assuring that noisy areas are surveyed to determine if they are hazardous noise areas and effectively prioritize noise surveys and noise remediation efforts;

c. Affirming the action level, criterion level, sound level, and exchange rate;

d. Evaluating and maintaining the HCP's effectiveness;

e. Implementing "Buy Quiet" and "Quiet by Design" Programs;

f. Performing and recording exposure monitoring and evaluating results;

g. Requiring effective intra-Center communication and coordination of Center disciplines to identify, evaluate, and control hazardous noise exposures;

h. Performing medical surveillance, including audiometric testing, review, and medical follow-up;

i. Notifying and coordinating information (noise exposure and dosimetry monitoring and survey results, operational and design plan review results, the addition of new equipment or new operations, and any work-related STS) among workers, management, and occupational health personnel;

j. Selecting, using, cleaning, and inspecting hearing protectors;

k. Training workers and supervisors of workers who are enrolled in a HCP;

l. Ensuring the Council for Accreditation of Occupational Hearing Conservation (CAOHC) certification of personnel performing audiometric testing. CAOHC certification is encouraged for nurse practitioners, physician assistants, and physicians. Professional Supervisor of Hearing Conservation is recommended for physicians evaluating work-relatedness of hearing loss;

m. Recordkeeping and accessing information in accordance with NASA's record requirements and this NPR;

n. Defining noise control requirements and strategies;

o. Effectively implementing engineering, operational, and administrative controls; and

p. Defining appropriate corrective actions for personnel and organizations that violate requirements of this section, the Center's HCP requirements, or 29 CFR 1910.95, "Occupational Noise Exposure Hearing Conservation Amendment Final Rule," and appendices.

4.8.3.2 "Buy Quiet and Quiet by Design" Programs shall:

a. Evaluate new equipment and systems to ensure they meet realistic and achievable noise emission criteria;

b. Encompass design, development, selection, and purchase of stationary and portable equipment purchased for use by Centers, including equipment purchased by contractors to minimize noise exposure hazards to workers;

c. Include all equipment expected to produce noise approaching hearing conservation levels of 80 dBA and higher;

d. Identify noise emission and control requirements for equipment procurement, specifications, and design;

e. Contain provisions for program support, promotion, training, and management sponsorship;

f. Be individualized to meet Center-specific needs, configuration, and other relevant factors;

g. Incorporate and follow the "Buy Quiet Roadmap" for all covered procurements. Centers are permitted to utilize an alternative formal process that provides equivalent documentation of key decisions, authorizations, and verifications.

4.8.3.3 Engineering Controls shall:

a. Be the first and primary means of controlling hazardous noise. The feasibility and cost of engineering controls may be considered when making decisions about these controls;

b. Aim to reduce noise emissions (measured at operator position or equivalent) to below 85 dBA; and

c. Be reviewed at least annually to assess the adequacy of precautions that are planned and/or implemented to control noise exposures.

4.8.3.4 Engineering projects shall include noise control measures and operational plans that have been previously coordinated with and approved by affected Center management organizations and occupational health personnel. Coordination shall be done in the early stages of the design and/or planning process, prior to contract award, and/or before "authority to proceed."

4.8.3.5 Organizations responsible for introducing changes to facilities, operations, or procedures shall notify Center occupational health personnel of:

a. Changes in operations or equipment that increases noise levels; and

b. New, uncontrolled, or previously unidentified areas, operations, or equipment that may produce hazardous noise or may not comply with the requirements of this section.

4.8.3.6 If engineering controls fail to reduce sound levels to the requirements specified in this section, administrative controls shall be utilized. Examples of administrative controls include access restrictions and time limitations in the hazardous noise area. Specific requirements for administrative controls include maximizing the distance between the person and the hazardous noise source to the extent practical; and appropriately identifying hazardous noise areas.

4.8.3.7 If engineering and administrative controls fail to reduce sound levels to within the requirements specified in this section, exposures shall be brought to acceptable levels by using Hearing Protection Devices (HPDs).

4.8.3.8 Centers shall be responsible for identifying hazardous noise areas and hazardous noise producing equipment according to the following criteria:

a. Signs shall clearly indicate the presence of hazardous noise and state the requirement to wear hearing protection.

b. The signs shall be posted at the entrance(s) to or the periphery of hazardous noise area(s).

c. Power tools and machines that produce hazardous noise levels shall be labeled using decals, placards, or other signage with similar statements, and warning signs shall be posted in areas where hazardous noise-producing tools and machines are used.

4.8.3.9 Disposable HPDs shall be for the exclusive use of each person and shall not be traded or shared. Non-disposable HPDs shall be properly sanitized and inspected prior to use by another person.

4.8.3.10 HPDs shall attenuate noise exposure to an 8-hour, TWA of 85 dBA or less. For those persons with an STS, HPDs shall attenuate exposure to an 8-hour, TWA of 82 dBA or less. The published Noise Reduction Rating (NRR) value may be used, if available. When using de-rating criteria for each noise area, HPD attenuation shall be determined by the most conservative method for defining the NRR of HPDs.

4.8.3.11 The adequacy of HPD attenuation shall be re-evaluated whenever workers noise exposures increase.

4.8.3.12. Special hearing-protective equipment, such as sound-suppression or noise-cancellation communication headsets, shall be regularly inspected if they are used in hazardous noise areas.

4.8.3.13 Sound-suppression and noise-cancellation headsets that have been damaged, altered, or modified in any way that affect the attenuation characteristics shall not be used.

4.8.3.14 Where sound-suppression and noise-cancellation headsets are not permanently issued to individuals, such equipment shall be cleaned and sanitized before re-issuance.

4.8.3.15 Noisy areas shall be surveyed to determine if they are hazardous noise areas in accordance with the following requirements:

a. Measurement of potentially hazardous sound levels shall be conducted when any information, observation, or calculation indicates that a person may be exposed to noise at or above the action level (50 percent of the OEL). This includes, but is not limited to, times where there is a need to document representative noise exposures, where workers complain of excessive noise, or where it is difficult to understand a normal conversation when the speaker and listener face each other at a distance of 3 feet;

b. Noise surveys shall also be conducted whenever any changes to facilities, equipment, work practices, procedures, or noise-control measures alter potential noise exposures. A review of hazardous noise sources and controls, worker exposures, and work practices and procedures shall be conducted for changed conditions whenever a worker experiences an STS;

c. In determining TWA exposures, all continuous, intermittent, and impulsive sound levels shall be integrated into the noise measurements;

d. Octave band analysis shall be conducted, as necessary, to establish the characteristics of the noise source and to help determine appropriate abatement techniques;

e. When a noise survey is performed, it shall determine the presence of compounding hearing related circumstances present in the environment (e.g., certain solvents, heavy metals, carbon monoxide, heat, and vibration) to ensure proper mitigation;

f. Exposure monitoring shall be conducted when a noise survey shows that a worker/workers may be exposed to noise at or above 82 dBA, 8-hour TWA. The purpose of such monitoring is to determine the noise dose of the exposed worker(s), the representative exposure of similarly exposed workers, and, if warranted, the appropriate noise abatement techniques;

g. Operational plans shall be reviewed to assess the adequacy of precautions that are planned and/or implemented to control noise exposures;

h. Assessments shall be conducted of each operation, job, or procedure having the potential to create hazardous noise;

i. New equipment, operations, jobs, or procedures, with the potential for creating hazardous noise, shall be evaluated with regard to noise emissions prior to operational start up;

j. Workers and/or their representatives shall be provided an opportunity to observe noise dosimetry and area monitoring activities;

k. Affected workers shall be notified in writing of the results of noise dosimetry monitoring;

l. Employers of affected workers and their responsible occupational health program managers shall be notified when noise measurement data indicate that noise exposures equal or exceed the action level or the limitations of Table 1. Written reports of the hazardous noise surveys shall identify survey observations, findings, and conclusions and shall be provided to affected employees; and

m. Hazardous noise areas shall be identified, selected, and surveyed. A review of each hazardous noise area for changes in conditions, noise sources, and configuration shall be documented at least annually.

4.8.3.16 Instruments used to measure workers' noise exposures shall adhere to the following requirements:

a. Instruments shall be field-calibrated or calibrated to manufacture's specifications prior to use;

b. Instruments shall be checked and calibrated at least annually by the manufacturer, a representative of the manufacturer, or an approved laboratory; and

c. Sound-level meters used to measure worker noise exposures shall be set at "slow" response and A-weighting.

4.8.3.17 Audiometric test equipment shall be calibrated to meet the requirements specified in the latest revision of ANSI S3.6, Specification for Audiometers.

4.8.3.18 Ambient noise levels in audiometric test rooms and booths shall meet the specifications in the latest version of ANSI S3.1, Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms.

4.8.3.19 Medical surveillance shall be provided to all workers enrolled in a HCP in accordance with the following requirements:

a. Workers receiving medical surveillance shall undergo a baseline audiometric examination before beginning work assignments in hazardous noise areas;

b. If it is not possible to obtain the baseline prior to noise assignment, then workers shall undergo a baseline audiometric examination within 30 days of initial exposure to hazardous noise. During this 30-day period, workers shall wear personal HPDs, which reduce their exposure to 82 dBA TWA or below. When it is discovered that workers have already been assigned to a position that may expose them to hazardous noise but have not yet had an audiometric examination:

(1) Audiometry shall be conducted within 30 days of the discovery, and workers shall wear personal hearing protection that reduces their exposure to 82 dBA TWA or below until audiometry has been conducted.

(2) A documented root cause analysis shall be made to determine the cause(s) of the oversight, and positive and affirmative action(s) taken to avoid recurrence.

c. Audiometric examinations shall include audiometry, an otoscopic examination by an audiologist, physician, or CAOHC certified Occupational Hearing Conservationist to identify any existing abnormal medical conditions of the ear, and an update to the person's medical record to document past noise exposure and other otopathological factors;

d. The person shall have no apparent or suspected ear, nose, or throat problems that might compromise the validity of the audiogram. When a person has an acute disease that may compromise the validity of the test, audiometry shall be delayed until the condition has abated;

e. The exposure and medical history taken at the time of the audiometric examination shall include ototoxic medications and exposure to ototoxic substances or materials;

f. Workers suffering from acute diseases of the ear shall not be placed in hazardous noise areas until the condition has abated, particularly if such diseases preclude the wearing of hearing protectors;

g. Centers shall take all reasonable measures to ensure that workers who have participated in the HCP medical surveillance program receive a final audiometric examination prior to termination of employment, transfer to duties not involving noise exposures, transfer to another installation, or retirement. An annual audiogram, if completed within six (6) months prior to termination, transfer, or retirement date, may serve as the final audiogram; and

h. When workers at a Center retain their "work role position" but change employers due to contract award to a new employer, all medical records applicable to hearing conservation shall follow them to their new employer, including their current baseline threshold.

4.8.3.20 Audiometric testing shall be performed upon initial assignment, and annually thereafter, in accordance with 29 CFR 1910.95, Sections (g) and (h) and additionally as follows:

a. Audiologists and/or physicians knowledgeable in hearing conservation shall oversee all audiometric testing conducted by CAOHC-certified Occupational Hearing Conservationists;

b. Personnel who conduct audiometric testing shall be familiar with the provisions of this section;

NOTE: An STS is defined as a decline in hearing threshold, relative to the baseline audiogram, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

c. All baseline audiograms and confirmation audiograms following the identification of an STS shall be preceded by a period of at least 14 hours during which there shall be no exposure to noise above 82 dBA TWA, on or off the job. Hearing protectors that lower workplace noise to the equivalent of 82 dBA TWA, using the appropriate noise-reduction rating, may be used to conform to this requirement;

d. If during any medical evaluation or audiometric examination the worker is identified as potentially unable to perform his or her job safely or has a hearing profile equal to or worse than that listed in Table 3 below, the worker and his or her employer shall receive a written notification of the requirement to perform a Functional Ability Evaluation. The written notification shall include results of pertinent work history and relevant conditions, e.g., visual impairment, that may affect ability to safely perform the work expected in the position held or to wear appropriate personal hearing protection equipment in a hazardous noise area.

Table 3

Frequency (Hz)	500	1000	2000	3000	4000	6000

Hearing Threshold Level (dB)	25	25	25	35	45	45

4.8.3.21 The requirements for handling threshold shifts are as follows:

a. The STS should be computed using the age corrections described in OSHA 29 CFR 1910.95, Appendix F;

b. Each employee's annual audiogram shall be compared to his/her baseline audiogram to determine if the audiogram is valid and to determine if an STS has occurred;

c. The baseline of each ear shall be separately tracked;

d. A physician, audiologist, or CAOHC-certified Occupational Hearing Conservationist shall perform the hearing test and make the comparison;

e. If an STS is identified and a confirmation audiogram is not obtained within 30 days, the STS shall become a confirmed STS by default;

f. If the identified STS is followed by a confirmation audiogram and the confirmation audiogram does not confirm the STS, this second audiogram replaces the first one;

g. If the identified STS is followed by a positive confirmation audiogram, the better of the two shall become the confirmed STS;

h. An audiologist or physician with hearing conservation experience shall review problem audiograms, including those showing an STS (either by confirmation within 30 days or by default) and shall determine whether there is a need for further evaluation.

i. When further evaluation is warranted, the worker shall be referred to an otolaryngologist or other qualified physician, or to an audiologist for further medical evaluation, and

j. A new baseline reference audiogram shall replace the original or previous baseline audiogram (in separate ears and not both ears, unless both ears meet criteria listed below) when:

(1) The reviewer determines that an STS is persistent on a retest (conducted no sooner than six (6) months later). Persons assigned a new baseline audiogram, as a result of an STS, shall receive an audiometric re-evaluation six (6) months after this assignment to determine if a further STS has occurred. The baseline shall be revised to the STS test which shows the lower (more sensitive) value for the average of thresholds at 2000, 3000, and 4000 Hz.

(2) A "significant improvement" is shown if the average of thresholds at 2000, 3000, and 4000 Hz for either ear shows an improvement of 5 dB or more from the baseline and the improvement is persistent in the next test. The baseline shall be revised to the improved test which shows the lower (more sensitive) value for the average of thresholds at 2000, 3000, and 4000 Hz. Age corrections shall not be used when determining "improvement."

(3) An audiologist or physician may determine that reasons exist for not revising an employee's baseline audiogram. In such cases, the audiologist or physician must document the reasons for not revising the baseline.

k. The worker, employer, and Center environmental health staff shall be notified of an STS in writing within 21 days of the determination of the STS;

l. If the worker's uncorrected hearing threshold level (HTL), without age correction (averaging 2000, 3000, and 4000 Hz) is 25 dB or greater above audiometric zero in the same ear as the STS, a work relatedness determination shall be made;

m. Based on the best available information, a physician or other licensed health care professional, in consultation with the employer, shall determine whether the noise-induced STS is work-related;

n. Unless a physician has determined that the STS is not work-related, the following actions shall be taken:

(1) The worker's management and responsible safety and health office shall be notified of the occurrence of an STS or other work-related hearing loss.

(2) The work-related hearing loss shall be relayed to the Center's mishap reporting system.

(3) The worker shall be notified and examined by a physician or an audiologist for proper HPD fit.

(4) HPDs shall be re-evaluated for effectiveness, and the worker shall be refitted, as necessary, with HPDs offering a greater sound attenuation.

(5) The worker shall be re-trained on the hazardous effects of noise and the need to use hearing protection.

(6) The work environment(s) shall be re-investigated to determine if work practices or changes in equipment or procedures have increased the noise hazard. Abatement actions shall be instituted, as necessary, with engineering controls employed as a first priority to reduce the potential for exposure to the action level.

(7) Any administrative and work practices being utilized to reduce noise exposures shall be reevaluated for effectiveness.

o. The Medical Director shall determine if reassignment to work in a low noise area is indicated to prevent further hearing impairment and shall advise the employer accordingly;

p. The employer shall have ultimate authority and responsibility for worker reassignment; and

q. Where the same worker experiences any subsequent work-related STS as a result of occupational noise exposure, the work environment(s) shall be re-evaluated. If the worker continues to work in the hazardous noise area(s), engineering and/or administrative controls shall be employed that reduce that worker's noise exposure to no more than 50 percent of what was previously allowed for that worker.

4.8.3.22 Unless a physician has determined a standard threshold shift is not work related or aggravated by occupational noise, the following steps shall be taken when an STS occurs:

a. Workers shall be referred to an otolaryngologist/physician knowledgeable in hearing conservation or to an audiologist for more comprehensive testing when it is suspected medical pathology of the ear is caused or aggravated by the wearing of hearing protectors;

b. Workers shall be informed of the need for an otological examination if a medical pathology of the ear unrelated to the use of hearing protectors is suspected; and

c. Workers shall be referred for persistent failure to obtain a valid audiogram.

4.8.3.22.1 To support the identification of larger changes in hearing that may be medically significant or result in communication difficulties, the following American Academy of Otolaryngology—Head and Neck Surgery occupational hearing referral criteria are recommended:

(1) An average HTL at 500, 1000, 2000, and 3000 Hz greater than 25 dB HTL in either ear (Baseline Audiogram).

(2) A difference in average HTL level between the better and poorer ears of more than 15 dB HTL at 500, 1000, and 2000 Hz (Baseline Audiogram).

(3) A change for the worse in average HTL in either ear compared to the baseline audiogram of more than 15 dB HTL at 500, 1000, and 2000 Hz or more than 20 dB HTL at 3000, 4000, and 6000 Hz (Periodic Audiograms).

(4) A history of ear pain; drainage; dizziness; severe, persistent tinnitus; sudden, fluctuating or rapidly progressive hearing loss; or a feeling of fullness or discomfort in one or both ears within the preceding 12 months (Any Audiogram).

(5) Earwax accumulation sufficient to completely obstruct the view of the eardrum during otoscopic examination or a foreign body is present in the ear canal.

4.8.3.23 The latest edition of the American Medical Association Guides to the Evaluation of Permanent Impairment shall be used as a guideline in determining hearing impairment.

4.8.3.24 All HCP and/or hazardous noise training shall be conducted based on the criteria of this section.

a. Each Occupational Hearing Conservationist shall receive CAOHC certification. A CAOHC refresher course shall be taken at least every five (5) years;

b. Occupational health personnel who conduct assessments shall receive initial training on their Center's hearing conservation program and in the hazards of noise exposure;

c. Workers and supervisors of workers enrolled in a HCPs shall receive annual training in the hazards of noise exposure; and

d. Annual training in the hazards of noise exposure shall include, at a minimum:

(1) An overview or review of the 29 CFR 1910.95, the Center's and employer's (if a contactor) HCP, and this section.

(2) The effects of hazardous noise and ototoxic substances or materials on hearing (including permanent hearing loss).

(3) Identification of the hazardous noise sources in the employee's work areas.

(4) Factors that may contribute to hearing loss.

(5) Noise-control principles.

(6) An explanation of the audiometric testing procedure and the purpose of audiometric testing.

(7) The employee's role and responsibilities in the HCP.

(8) The purpose of HPD's, including:

(a) The advantages, disadvantages, and attenuation characteristics of various types of HPD's;

(b) Instructions on selection, fit, use, and care of HPD's; and

(c) The recommendation that employees use hearing protection whenever there is exposure to hazardous noise during off-duty activities (e.g., lawn mowing, use of firearms).

4.8.3.25 Accurate HCP records shall be maintained as specified in the applicable records retention schedules in NPR 1441.1 and the Records Management Plan for the NASA Electronic Health Record System.

4.8.3.26 Records kept shall follow the requirements of NPR 1441.1, NASA Records Retention Schedules, and shall include, but are not limited to:

a. The Center's written HCP and subsequent revisions;

b. A comprehensive registry of all workers placed in the HCP;*

c. Audiometric tests and records;*

d. Background sound pressure levels of audiometric test rooms;

e. Data and information concerning repair of audiometers;

f. Hazardous noise area locations and noise levels recorded in those areas;

g. Survey and dosimetry results and recommendations;*

h. Data and information concerning calibration and repair of sound-measuring equipment;

i. The employee's most recent noise-exposure assessment;

j. Special noise studies;

k. Remedial actions recommended/taken;

l. Engineering controls installed;

m. Results of design and operational reviews;

n. Training; and

o. Hearing protector selection.

NOTE: Items above marked with an asterisk (*) shall be maintained for at least 30 years.

4.8.3.27 Documentation of other official HCP-related activities shall be as follows:

a. Audiometric test records shall include, as a minimum:

(1) Hearing threshold levels at 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz.

(2) The audiometric reference level to which the audiometer was calibrated at the time of testing.

(3) The date of the audiogram.

(4) The worker's first and last names, employee number, and job classification.

(5) The examiner's name and position.

(6) The date of the last calibration of the audiometer.

b. Audiograms and noise-exposure records shall be maintained as a permanent part of a worker's medical record;

c. When noise-exposure-measurement records are representative of the exposures of other individuals participating in the HCP and to the extent allowable by the Privacy Act and where applicable to the HIPAA, the range of noise levels and the average noise doses shall be made a permanent part of the medical records of those other individuals; and

d. Consistent with applicable requirements, copies of this section, 29 CFR 1910.95, and any other records required by this section, shall be provided upon written request to:

(1) Workers and former workers and their representatives.

(2) Representatives of the U.S. Department of Labor.

(3) The National Institute for Occupational Safety and Health (NIOSH).

(4) NASA Occupational Health Program personnel.

4.9 Ergonomics

4.9.1 General

4.9.1.1 NASA Centers shall encourage participation in developing, implementing, and evaluating ergonomics programs.

4.9.1.2 Musculoskeletal Disease (MSD) signs and symptoms shall be evaluated in all areas where potential ergonomic hazards exist, and that ergonomic hazards be eliminated, reduced to the extent feasible, or materially reduced using an incremental abatement process.

4.9.1.3 Workers shall be encouraged to participate in ergonomics programs and report MSD's signs or symptoms.

4.9.1.4 Industry standards applicable to ergonomic equipment shall be considered requirements of this section.

4.9.2 Responsibilities

4.9.2.1 The OCHMO shall provide guidance and advice to NASA Centers on ergonomics.

4.9.2.2 The Director of Health and Medical Systems shall ensure Center ergonomics policy and programs are assessed for efficacy through regular, periodic reviews.

4.9.2.3 Centers shall implement an ergonomics program to ensure proper fit between the job tasks, equipment, and the worker performing the duties.

4.9.2.4 Centers shall develop and maintain effective ergonomic programs, consistent with the requirements stated herein and with current professional guidance from organizations such as OSHA and NIOSH.

4.9.2.5 Centers shall assure that industrial hygiene is involved in the selection of the computer workstations and that a member of the industrial hygiene group is involved with the procurement of computer workstations.

4.9.3 Process Description

4.9.3.1 Each Center shall have a written ergonomics program that includes at least the following elements:

a. Management support and employee participation;

b. Worksite analysis;

c. Job analysis;

d. Medical management;

e. Training; and

f. Program evaluation.

4.9.3.2 At a minimum, management support of the ergonomics program shall be demonstrated by approving a Center ergonomic policy. Workers (and their designated representatives) shall have ways to report signs and symptoms of musculoskeletal disorders (MSDs); obtain responses to reports; and participate in developing, implementing, and evaluating each element of the program. Policies or practices shall encourage workers to participate in the program and report signs and symptoms of MSDs. A method for workers to report signs and symptoms of MSDs and to get prompt response and followup shall be established. Worker reports of signs and symptoms of an MSD shall be evaluated to determine whether an MSD has occurred. Information to workers shall be periodically provided that explains how to identify and report signs and symptoms of an MSD.

4.9.3.3 A worksite analysis shall be performed in all areas where potential ergonomic hazards exist and whenever operations are introduced or modified creating the potential for new ergonomic hazards. This includes, but is not limited to, examination and tracking of injury and illness records to identify patterns of traumas or strains that may indicate the development of MSDs.

4.9.3.4 Operations with significant ergonomic risk factors present shall be analyzed to fully define the ergonomic risk factors that could result in MSD hazards. The ergonomic hazards shall be eliminated, reduced to the extent feasible, or materially reduced using an incremental abatement process.

4.9.3.5 A medical intervention and/or management program shall be designed and implemented to eliminate or reduce the risk of development of MSDs through early identification and treatment. The program shall be implemented by qualified medical providers. Concerted efforts shall be made to return workers to work as soon as possible.

4.9.3.6 Workers shall be provided proper ergonomic training to make them aware of the ergonomics program, common MSD hazards, and methods for eliminating MSD hazards.

4.9.3.7 Center ergonomic programs shall be re-evaluated at least annually and changes implemented to ensure coverage of all potential ergonomics hazards. Metrics that document the efficacy of the ergonomics program shall be maintained and used to improve the program and further reduce MSD risks.

4.10 Indoor Air Quality (IAQ)

4.10.1 General

4.10.1.1 NASA Centers shall eliminate or minimize indoor air-related hazards (i.e., visible mold, pesticides, ozone from copiers, insufficient ventilation, chemicals in open containers, outdoor sources, etc.) that may contribute to IAQ problems.

4.10.1.2 NASA Centers shall minimize the impact of construction, renovation, and maintenance activities on IAQ; resolve all IAQ problems; and communicate IAQ information to affected employees.

4.10.1.3 This section outlines the requirements to minimize the negative impact that poor IAQ can have in the workplace on worker health, productivity, morale, and absenteeism, and establishes minimum standards for all NASA Center IAQ programs with regard to complaint investigation, IAQ testing, communication of IAQ information, mold remediation, recordkeeping, and general requirements.

4.10.2 Responsibilities

4.10.2.1 The OCHMO shall provide guidance and advice to NASA Centers on IAQ.

4.10.2.2 The Director of Health and Medical Systems shall ensure Center IAQ policy and programs are assessed for efficacy through regular, periodic reviews.

4.10.2.3 Centers shall have written IAQ programs intended to ensure all indoor environments are adequately controlled for recognized IAQ-related hazards.

4.10.2.4 Centers shall ensure that their IAQ programs include provisions for:

a. Investigating IAQ complaints, conducting IAQ testing, offering technical guidance and support on minimizing the impact of construction, renovation, and maintenance activities on IAQ, recommending corrective actions to resolve all IAQ problems, communicating IAQ information to employees, remediating mold, and recordkeeping;

b. Evaluating the medical condition of workers who report signs or symptoms that they suspect may be related to indoor air contaminants;

c. Evaluating building heating, ventilation, and air-conditioning (HVAC) system designs and modifications to determine if recommended standards, including the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) guidelines are met and do not adversely affect local exhaust ventilation systems used to control hazardous materials; and

d. Evaluating housekeeping services to help ensure they are minimizing dust accumulation and food wastes and maintaining floor surfaces (including carpets) in a manner sufficient to lessen the likelihood of IAQ complaints.

e. Evaluate the process for moisture control and mold remediation to help ensure it is effective. When mold is found to be present, the Center shall develop a plan for remediation. The methods used for mold remediation depend on the type of material and the extent of the area with mold growth and shall be commensurate with current governmental, industry, and consensus guidelines and recommendations.

4.10.3 Process Description

4.10.3.1 Centers shall involve the cooperation of other internal organizations in IAQ investigations, including, but not limited to, affected individuals, IH, occupational medicine, building managers, janitorial staff, maintenance, and operations staff.

4.10.3.2 An open, transparent, and effective communication process with affected workers regarding an IAQ investigation's findings and subsequent corrective actions shall be developed and followed for significant IAQ problems. This process shall include both verbal and written communication and shall be continued until the IAQ concern is effectively resolved. Communication efforts shall start at the earliest stages of an IAQ investigation.

4.10.3.3 IAQ investigations shall follow three basic steps (these are not necessarily distinct stages and some may be intermixed depending on the situation and discretion of the investigator):

a. Identification and investigation of the IAQ concern by competent personnel. This shall be done by the appropriate IH organization;

b. Collection of appropriate and representative samples and other survey documentation; and

c. Evaluation of data, recommendations and conclusions, and report generation.

4.10.3.4 Workers shall be notified about building conditions, policies, procedures, and plans that may have a significant adverse impact (e.g., planned renovation, remodeling, and maintenance or pest control activities) on indoor air quality and operational activities.

4.10.3.5 Center EH personnel shall collaborate with facilities maintenance and operational management personnel to ensure the following additional IAQ best practice requirements are incorporated into each Center's IAQ program:

a. Construction and maintenance activities in occupied buildings shall be planned and managed to minimize the release of dust, vapors, fumes, and other air contaminants to protect workers and building occupants;

b. Building and office materials such as paint, carpet, upholstery, cushions, adhesives, and furniture shall be low/no volatile organic compound emitting and shall not significantly contribute to IAQ problems;

c. Carpets shall be maintained in an effort to ensure they do not become a source of dust, mold, bacteria, and other indoor air contaminants;

d. Integrated Pest Management principles shall be followed to minimize occupant exposure to pest- and pesticide-related contaminants and shall be used to reduce vapors and dusts created during pesticide applications;

e. Parked vehicles, such as those in loading docks, shall not be allowed to remain running in close proximity to building air intakes where exhaust contaminants may be entrained into the building;

f. Designated smoking areas shall not be near air intake systems or entry/exit doors where smoke may be entrained into the building;

g. Water spills and leaks shall be immediately attended to and water leaks reported without delay;

h. Decorative plants shall be maintained properly as to not create an environment for mold or bacteria; and

i. Water reservoirs (i.e., cooling towers, condensate pans, hot water tanks, stagnant plumbing systems such as eye washes) shall be maintained to limit biological growth.

4.10.3.6 At the conclusion of the IAQ investigation, results shall be evaluated and conclusions and recommendations derived and documented. A summary of this information shall be compiled into a report and distributed and communicated to all affected parties.

4.10.3.7 Records shall be maintained as objective evidence of compliance with this section. The following records shall be maintained for all IAQ investigations:

a. A log of IAQ complaints;

b. All IAQ interview questionnaires and forms;

c. Any monitoring and IH sampling conducted during the investigation; and

d. All IAQ reports with conclusions and recommendations.

4.11 Biosafety

4.11.1 General

4.11.1.1 NASA Centers shall protect the health of workers and others from the risks associated with the use of hazardous biological agents.

4.11.1.2 The scope of these requirements is limited to direct work and handling of biological hazards. This includes, but is not limited to, non-medical biological laboratory workers and animal handlers.

4.11.1.3 These requirements do not apply to potential or incidental exposure to biological hazards because of a complication to one's normal industrial work (such as a plumber or custodian) or to clinical medical functions. Such aspects shall be covered under program- or project-specific plans and procedures.

4.11.1.4 For purposes of these requirements, the hazards associated with Animal Biosafety Levels (ABSL) and the Biosafety Levels (BSLs) described in the CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL) are equivalent. All BSL requirements apply to ABSLs. Equivalent control measures shall be taken to protect workers from potential exposures to animal borne biological agents. The co-application of BSL's, ABSL's, and National Institutes of Health (NIH) Risk Groups (RGs) shall be determined by a protocol driven risk assessment, and the exposure controls adjusted accordingly.

4.11.1.5 Work with prions, BSL 3 or 4, and RG 3 or 4 agents is prohibited.

4.11.2 Responsibilities

4.11.2.1 The OCHMO shall provide guidance and advice to NASA Centers on biosafety.

4.11.2.2 The Director of Health and Medical Systems shall ensure Center biosafety policy and programs are assessed for efficacy through regular, periodic reviews.

4.11.2.3 Centers shall have written biosafety programs that ensure implementation of the provisions of this section.

4.11.2.4 Center Medical Directors shall:

a. Design medical support services in consultation with representatives from the institutional environmental health and safety and principal investigators;

b. Approve all uses of BSL-1 or 2 and RG-1 or 2 agents and animals on a case-by-case basis prior to their presence on Center;

c. Approve all uses of genetically-modified agents or recombinant deoxyribonucleic acid (DNA) molecules on a case-by-case basis prior to their presence on Center;

d. Ensure the medical clinic is cognizant of potential hazards encountered by personnel working with biohazards; and

e. Evaluate affected workers previous and ongoing medical conditions, current medications, allergies (i.e., medicines, animals, and other environmental proteins) and prior immunizations, and determine what medical services are needed to permit safe performance of the duties of the position.

4.11.2.5 Environmental Health organizations shall:

a. Review and approve all proposed facility designs and equipment purchases for use with biohazardous agents prior to their procurements;

b. Review and assess procedures that impart energy to a microbial suspension or that produce aerosols;

c. Review and assess the knowledge and experience of the intended user; and

d. Inspect and certify the safety of biological safety cabinets (BSC) and other containment devices before use and at least annually, thereafter or more frequently if required by local authorities or recommended by the manufacturer to conform to the requirements of this section and NSF/ANSI Standard 49 Biosafety Cabinetry: Design, Construction, Performance, and Field Certification.

4.11.2.6 Supervisors shall:

a. Provide a description of the requirements, proposed tasks, and responsibilities of each position involving hazardous biological agents to the Medical Director to guide the medical evaluation; and

b. Cooperate with EH professionals to identify the potential worksite biohazards.

4.11.3 Process Description

4.11.3.1 The applicable recommended practices, requirements, safety equipment, training, and facility safeguards described in the latest edition of the following documents and their appendices are mandatory.

a. Centers for Disease Control and Prevention (CDC) publication, *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*;

b. NIH *Guidelines for Research Involving Recombinant DNA Molecules*.

c. International Civil Aviation Organization requirements for transportation of etiologic agents and infectious materials;

d. Public Health Service Foreign Quarantine regulations; and

e. National Academies Publication, *Guide for the Care and Use of Laboratory Animals.*

4.11.3.2 Except as otherwise defined in this document, Centers shall classify BSLs and RGs; provide applicable levels of containment; use the standard practices, safety equipment, facility, and training requirements; and handle biological agents according to the most recent recommended criteria in the CDC publication, *Biosafety in Microbiological and Biomedical Laboratories (BMBL) and NIH Guidelines for Research Involving Recombinant DNA Molecules*.

4.11.3.3 Centers using biologically hazardous materials, agents, and/or animals shall develop a written Biosafety Plan that outlines their approach for adhering to the mandatory requirements of all applicable regulators. The plan shall include provisions for engineering controls, administrative controls, work practices, decontamination, infectious

waste management, and disposal.

4.11.3.4 Centers using biologically hazardous materials, agents, and/or animals shall develop a Biosafety Operations Manual that identifies specific hazards that may be encountered and that specifies practices and procedures designed to minimize or eliminate exposures to those hazards.

4.11.3.5 A risk assessment shall be conducted on all work with biologically hazardous materials, agents, and/or animals, including mammalian tissues or cells.

4.11.3.6 Personnel working with biologically hazardous materials, agents, and/or animals shall work under the policies and guidelines established by the Center's Biosafety Plan and Operations Manual.

4.11.3.7 The following biological agents are prohibited from use at all NASA Centers:

a. Select agents and toxins covered under 42 CFR part 73, 7 CFR 331 and 9 CFR 121;

b. Prions;

c. BSL-3 and 4 agents; and

d. RG-3 and 4 agents.

4.11.3.8 Centers shall adhere to the following training requirements when using biohazardous agents:

a. Personnel using biohazardous agents shall be trained and knowledgeable about the risks to which they may be occupationally exposed, the types of exposures that place their health at risk, the nature and significance of such risks, as well as the appropriate first aid and followup for potential exposures. Workers shall read, understand, and follow the required practices and procedures and shall consult with safety or health professionals with regard to risk assessment prior to use of those materials or organisms;

b. Refresher training shall be provided at least annually, at the time of any significant change in job responsibility, and following recognized and suspected exposures;

c. Centers conducting experiments at a BSL-1 or 2 and RG-1 or 2 shall use workers who are adequately trained and experienced;

4.11.3.9 Centers shall meet the following criteria for work involving hazardous biological agents:

a. Personnel working with human cells and tissues that are capable of transmitting disease shall be enrolled in an occupational medicine BBP program;

b. Workers using biohazardous agents shall be fully informed of the available medical support services and encouraged to utilize them;

c. Workers who may be occupationally exposed to human pathogens in research settings shall receive a pre-placement medical evaluation;

d. Medical support services for biohazards shall be based upon risk assessments and tailored to meet the organization's needs.

e. Medical support services shall be provided for all personnel equally regardless of employment status.

f. Capabilities for providing medical support for workers shall be in place before work actually begins;

g. The medical provider shall be knowledgeable about the nature of potential health risks in the work environment and have access to expert consultation;

h. Medical support services for biomedical research facilities shall be evaluated at least annually, and;

i. Joint annual review of occupational injury and illness reports by healthcare providers, environmental health, and safety representatives shall be performed to assist in revision of exposure prevention strategies to minimize biological health hazards that cannot be eliminated.

4.11.3.10 Disposal of wastes contaminated with biological agents and/or potentially infectious materials shall be handled in accordance with the Center's infectious, biological, and/or hazardous waste disposal procedures and policies.

4.12 Food Safety

4.12.1 General

4.12.1.1 NASA Centers shall use the latest version of the United States Department of Health and Human Services (HHS), Food and Drug Administration (FDA) Food Code, and the Hazard Analysis Critical Control Point (HACCP) methodology (prevention-oriented, science-based food safety principles) as the primary means of regulating food

safety at food establishments under NASA jurisdiction.

4.12.1.2 NASA Centers shall ensure food safety through the implementation of appropriate procedures, training, and active monitoring to reduce risk.

4.12.1.3 OCHMO is the overall NASA authority for food safety and coordinates food safety matters with outside agencies.

4.12.1.4 Centers shall determine the best ways to ensure food establishments develop procedures, effectively train their associates, and verify that those procedures are being implemented.

4.12.1.5 The Food Safety requirements contained herein apply to all retail food establishments operated by NASA or NASA Contractors.

4.12.1.6 The FDA Food Code shall be the minimum standard for controlling the risk factors known to contribute to foodborne illness at NASA Facilities.

4.12.1.7 Food safety measures established in the most recent version of Food Code shall be accomplished through the implementation of HACCP principles and risk-based inspections and controls.

4.12.1.8 Where conflicts exist between the most recent FDA Food Code, this section and any additional state or local "food code" requirements, whichever is most protective shall be applied.

4.12.1.9 Where conflicts exist between this section and any additional Center requirements, whichever is most protective shall be applied.

4.12.2 Responsibilities

4.12.2.1 The OCHMO shall provide guidance and advice to NASA Centers on food safety.

4.12.2.2 The Director of Health and Medical Systems shall ensure Center food safety policy and programs are assessed for efficacy through regular, periodic reviews.

4.12.2.3 Centers shall mitigate potential food safety hazards by establishing a primary prevention approach to food safety that encompasses planning and reviews of all proposed projects, processes, and procedures to mitigate potential food safety hazards.

4.12.2.4 Centers shall notify OCHMO of food-related incidents as soon as possible and by the most expeditious means.

4.12.2.5 Centers shall:

a. Only allow operations of food service establishments that meet or exceed the minimum acceptable requirements established by this section and applicable Federal, state, and local regulations for the safe handling of food;

b. Ensure that the requirements and provisions of this section are included in food and beverage services contracts, subcontracts, and other applicable contracts/agreements;

c. Maintain current food safety policy and procedures which assign responsibility, accountability, and authority to pertinent Center organizations, departments, and personnel;

d. Ensure the food safety program has an established system to detect, collect, investigate, and respond to complaints and emergencies that involve foodborne illness, injury, and intentional and unintentional food contamination;

e. Promote a comprehensive awareness and active managerial control over risk factors most

commonly associated with foodborne illnesses;

f. Ensure that food establishments' food safety management plans implement sound food safety practices;

g. Ensure that food establishments implement food safety management plans that incorporate active managerial controls, HACCP principles, training requirements, hygiene standards, cleaning and sanitary practices, illness reporting agreements, food hazards of significance, monitoring procedures, record keeping, corrective action processes, and proper certification of food service workers;

h. Ensure that Critical Control Points (CCPs) and Critical Limits (CLs) are included in recipes or recipes are controlled via an overall policy that is based on the current FDA Food Code and HACCP methodology and principles;

i. Ensure Center Food Safety Program elements are implemented and maintained;

j. Coordinate questionable conflicts between the latest FDA Food Code and local "food code" with the local authorities;

k. Conduct a program of continuing inspection and surveillance of all food establishments;

l. Ensure the inspection program focuses on the status of risk factors, determines and documents compliance, and targets immediate- and long-term correction of out-of-control risk factors through active managerial control;

m. Ensure program management has established quality assurance measures to ensure uniformity among inspection staff in the interpretation and application of laws, regulations, policies, and procedures;

n. Ensure that Food Safety Inspection personnel have the knowledge, skills, and ability to adequately perform their required duties;

o. Perform onsite, risk-based food safety inspections of food establishments as recommended by the FDA Food Code, Annex 5, Table 1. Inspections shall include:

(1) Identification and assessment of the hazards and associated risks.

(2) Determination of and implementation of CCPs, CLs, and procedures necessary to reduce risk of foodborne illness.

(3) Determination of active managerial controls.

p. Maintain accurate and complete survey and inspection data records for the last three months or last three inspections, whichever time span is greater, and have them available for review by inspection personnel and food installation customers;

q. Correct all inspection violations in a reasonable length of time;

r. Prominently post the most recent inspection report for customers to view or a sign or placard notifying customers that inspectional information is available for review;

s. Provide consultation in the preparation of state and/or local permit applications for food service activities;

t. Ensure compliance monitoring and reporting is carried out in a timely manner;

u. Ensure compliance and enforcement activities result in followup actions for out-of-control risk factors and timely correction of violations;

v. Maintain copies of state and/or local permits, and associated records;

w. Notify local and state health departments, the CDC, and/or the Department of Homeland Security, consistent with applicable reporting requirements, of foodborne disease outbreaks;

x. Ensure that Center Senior Management is routinely apprised of the status of major food safety issues and problems;

y. Ensure that OCHMO and the Center OH Office are immediately advised of major accidents, incidents, or emergencies involving food safety.

z. Ensure that Center policy and food safety plans require prompt notification of a responsible individual in the event of an emergency resulting in conditions that could create an imminent hazard (e.g., fire, flood, extended interruption of electrical service or water service, sewage backup, a report of foodborne illness) or any other unsanitary occurrence/condition that might contaminate food and endanger employee health.;

aa. Ensure design reviews are conducted for new or redesigned food establishments, as well as for facilities that intend to make significant changes to the existing menu or theme;

bb. Ensure that food safety personnel and food inspection personnel are included in the procurement of food establishment equipment and Facility design reviews;

cc. Provide design and procedure reviews, technical assistance, and consultation with all Center stakeholder organizations on matters concerning food safety;

dd. Ensure the review of plans by qualified individuals for temporary events that involve food and provide recommendations concerning food safety provisions;

ee. Ensure that proper food handler physical examinations are provided to food services workers as per Appendix C of this NPR;

> *NOTE: Centers may offer Hepatitis A inoculations to food services workers who work at food establishments on NASA property or under NASA jurisdiction at the discretion of Center Management.*

ff. Ensure all food handlers report to a physician when any symptoms of infections and/or communicable diseases are present;

gg. Ensure that food service workers immediately report symptoms of illness that may be transmissible through food to their supervisor;

hh. Ensure that all food handlers returning to work after an illness-related absence associated with any of the conditions below are medically cleared:

(1) A diagnosed illness of Norovirus, typhoid fever (Salmonella typhi), shigellosis (Shigella spp.), E. coli O157:H7 infection (or other EHEC/STEC (enterohemorrhagic or Shiga toxin-producing E. coli), or Hepatitis A virus (Hepatitis A) or nontyphoidal Salmonella.

(2) Symptoms of gastrointestinal illness such as diarrhea, fever, vomiting, jaundice, or sore throat with fever.

(3) A lesion, boil, or wound containing pus that is open or draining and is located on the hands, wrists, or exposed portions of arms.

(4) Illness from consuming food that was implicated in or caused an outbreak.

ii. Identify and provide support concerning certification and training requirements for food managers and food service workers;

jj. Ensure that training is provided to maintain any certification requirements food service managers may need;

kk. Ensure all food handlers receive refresher training on a routine basis to ensure food safety principles and practices are reinforced.

ll. Remove from service or sale all food items suspected to be contaminated, unwholesome, out-of-date, or otherwise deemed unfit for consumption;

mm. Ensure that organizations operating vending machines that dispense Temperature Controlled for Safety (TCS) food or beverage items provide the Center OH Office with a list of onsite vending machines and their locations; and

nn. Ensure that vermin are controlled through an Integrated Pest Management (IPM) program that integrates housekeeping, maintenance, and pest control services to prevent the creation of a health hazard to humans. The IPM program shall be site specific and tailored to food establishment operations.

4.12.3 Process Description

4.12.3.1 Food served or vended at NASA Centers and Component Facilities shall be from approved sources that are monitored and regulated under Federal, state, or local food safety inspection programs. Food shall be protected during all stages of production to assure that it is safe and unadulterated. This applies to the receiving, transporting, storing, preparing, serving, and vending of food provided. This applies equally to all appropriated funded, non-appropriated funded, organizational, contractor, and/or private association food activities held on Centers.

4.12.3.2 Food operators shall comply with HACCP methodology and principles and the latest FDA Food Code.

4.12.3.3 Food operators shall have written food safety policies and written food safety plans (specific to establishments) that ensures that HACCP principles and methodology implements a process of self-inspection and continuous improvement. The management system shall provide for effective and active managerial control and the purposeful incorporation of specific actions or procedures into the operation of food service establishments to attain control over foodborne illness risk factors. Unique conditions within each Facility shall be considered during the development of food safety and HACCP plans. Generic plans are not acceptable. Food safety plans shall identify potential hazards of significance and include preventive measures to ensure and improve food safety. CCPs shall be effectively controlled and CLs shall be properly observed and implemented.

4.12.3.4 Constraints/controls imposed upon substances/products/operations subject to the provisions of this section shall be no less than those required by applicable regulatory authorities and shall include any additional special constraints deemed necessary by OCHMO as a result of unique or operational characteristics.

4.12.3.5 Centers shall generate, retain, and dispose of food safety records according to NASA EH records requirements found in NPR 1441.1, NASA Records Retention Schedules.

4.12.3.6 Records shall be available for review by the OCHMO and Federal, state, and/or local food safety inspectors. Examples of records include applicable training records, inspection records, walk-in refrigerator/freezer daily alarm check logs, temperature logs, food receiving logs, maintenance logs, and dishwasher logs.

4.12.3.7 New and redesigned facilities shall be reviewed by the Center OH Office and meet the principles outlined in state and local codes and the FDA Food Code. All design deviations and changes that may affect the Center's Food Safety Program requirements shall be coordinated with appropriate Center personnel and stakeholders; and approved in advance by the Center's OH representative.

4.13 Radiation, General

4.13.1 General

4.13.1.1 Health Physics is the application of scientific principles to the protection of workers and others from the hazards of radiation. NASA Centers shall maintain and preserve the radiological health of their workforce by minimizing occupational exposures, eliminating unnecessary exposures, and reducing the potential for accidental exposures to ionizing and non-ionizing radiation.

4.13.1.2 The OSMA maintains purview concerning the launching of radioactive materials.

4.13.1.3 Exposures to ionizing radiation shall be maintained As Low As Reasonably Achievable (ALARA) and exposures to nonionizing radiation shall be maintained ALARP.

4.13.2 Responsibilities

4.13.2.1 The OCHMO shall provide guidance and advice to NASA Centers on radiation.

4.13.2.2 The Director of Health and Medical Systems shall ensure Center radiation policy and programs are assessed for efficacy through regular, periodic reviews.

4.13.2.3 The SEHO shall recommend Agency-level radiation policy and requirements to the CHMO.

4.13.2.4 Centers shall achieve the ALARA objective by the use of active managerial controls, safe operating procedures, appropriate equipment, a comprehensive maintenance and surveillance program, adequate shielding and distance, and/or by limiting worker exposure time.

4.13.2.5 Centers shall designate in writing competent and qualified approval authorities to administer radiation protection programs.

4.13.2.6 Centers shall have centralized control and accountability over sources of potentially hazardous ionizing and non-ionizing radiation.

4.13.2.7 Centers shall ensure compliance with applicable Federal, state, and local requirements through independent quality assurance checks.

4.13.2.8 Centers shall ensure that adequate personnel, facilities, equipment, training, and operational and emergency controls are maintained for all operations utilizing ionizing or nonionizing radiation.

4.13.2.9 Centers shall ensure that radiation sources are used safely and in accordance with written procedures based on sound radiation protection and engineering principles.

4.13.3 Process Description

4.13.3.1 Centers in which operations exist that expose workers or the public to ionizing and nonionizing radiation shall administer a comprehensive radiation protection program to identify and control those radiation exposures in accordance with this section.

4.13.3.2 Radiation protection programs shall be implemented by written procedures and reviewed at least once every 12 months to evaluate their content and effective implementation. At a minimum, the review shall cover procedural compliance, technical adequacy, implementation, and effectiveness of the program.

4.13.3.3 Training shall be provided according to the following criteria:

a. Training shall be commensurate with the potential hazards and provided prior to unescorted access to restricted areas and prior to receiving occupational exposure;

b. Initial and recurrent training shall provide the knowledge, skills, and abilities necessary for maintaining radiation workers' doses below applicable limits;

c. Training shall provide workers with an understanding of the risks associated with radiation and the means for recognizing and addressing workplace hazards that may lead to increased risks; and

d. Female radiation workers who may be occupationally exposed to the ionizing radiation dose threshold (i.e., 100 millirem) and their supervisors shall receive special instructions on the potential health risks of prenatal exposure to ionizing radiation.

NOTE: Paragraph 4.5.1.3 and 4.5.3.1(f) and (g) contain additional information about exposure of female radiation workers.

4.13.3.4 Only persons qualified by training shall be authorized to use potentially hazardous ionizing or non-ionizing radiation.

4.13.3.5 Medical surveillance shall be conducted in accordance with Chapter 2 of this NPR.

4.13.3.6 A comprehensive inventory of all hazardous ionizing and nonionizing radiation sources shall be completed

and verified annually.

4.13.3.7 A formalized approval process based on hazards analyses shall be implemented prior to the authorization of any source of hazardous ionizing and/or non-ionizing radiation.

4.13.3.8 To the maximum extent practicable, hazards to workers shall be eliminated by engineering design.

4.13.3.9 Procedures shall be developed and/or equipment provided to mitigate hazards that cannot be eliminated by engineering design.

4.13.3.10 Work activities shall be conducted as specified by the controlling written authorization.

4.13.3.11 Sources of potentially hazardous ionizing and non-ionizing radiation, whether in use or in storage, shall be controlled and secured from unauthorized access or removal according to the following criteria:

a. Controls shall be commensurate with the hazards and provide flexibility for consideration of other hazards (e.g., industrial safety, industrial hygiene, environmental hazards);

b. Use and storage locations shall afford adequate safety and security;

c. Restricted areas shall be established and posted to warn individuals that they are entering areas controlled for radiation protection purposes. Access shall be limited to authorized personnel; and

d. Activities involving ionizing or non-ionizing radiation determined to be a threat to health or property shall be immediately terminated.

4.13.3.12 Written operating, maintenance, service, and emergency procedures and use authorizing documentation shall be provided and maintained with ionizing or non-ionizing radiation sources for easily accessible reference. These procedures and procedural controls shall be commensurate with the hazards, activity, and the education, training, and skills of the individuals who may be exposed to the hazards.

4.13.3.13 A competent person (see Appendix A) trained to evaluate and document the magnitude and extent of radiation emissions and potential radiological hazards, and to verify the efficacy of controls and procedures shall perform surveillance and monitoring of approved facilities, equipment, and operations in accordance with the following specifications:

a. Surveillance and monitoring shall be conducted at least annually based on applicable regulatory requirements and license conditions. Surveillance and monitoring shall be commensurate with the potential for changes in the radiation fields and the potential magnitude of the changes;

b. Instrumentation that is used to perform radiation surveys shall be capable of accurately measuring the types of radiation, at the dose rates and under the environmental conditions that may be encountered;

c. Instruments and equipment used for quantitative radiation measurements shall be calibrated for the radiation measured at intervals not to exceed 12 months or per the manufacturer's recommendation;

d. When components affecting the radiation safety of a system are serviced or replaced, a qualified expert shall perform a survey of the installations to ensure continuity of adequate radiation safety; and

e. Surveillance and monitoring results shall be evaluated and investigations initiated to resolve unexpected results.

4.13.3.14 Exposures to ionizing and nonionizing radiation in excess of the applicable regulatory limits shall be reported to the appropriate regulatory authorities according to the regulations and to the SEHO by the most expeditious means.

4.13.3.15 Records shall be maintained to document conformance to this section, applicable regulations and standards, and with the provisions of Center's radiation protection programs. Unless otherwise specified in this section, records shall be retained until final disposition is authorized in accordance with NPR 1441.1D, NASA Record Retention Schedules.

4.14 Radioactive Materials

4.14.1 General

4.14.1.1 The receipt, use, storage or transfer of radioactive materials, or equipment containing radioactive materials shall be controlled at all NASA Centers.

4.14.1.2 All procurement, use, transfer, and disposal of radioactive materials shall be coordinated with the designated radiation protection competent approval authority (e.g., Laser Safety Officer (LSO), Radiation Safety Officer (RSO), Radiation Safety Committee (RSC), etc.).

4.14.1.3 Exposures to ionizing radiation shall be maintained ALARA. Occupational exposure to naturally occurring radon shall be maintained ALARP.

4.14.2 Responsibilities

4.14.2.1 The OCHMO shall provide guidance and advice to NASA Centers on radioactive materials.

4.14.2.2 The Director of Health and Medical Systems shall ensure Center radioactive materials policy and programs are assessed for efficacy through regular, periodic reviews.

4.14.2.3 Center Senior Management shall designate in writing, competent and qualified personnel to administer a program for control and accountability of radioactive materials.

4.14.2.4 Center RSO and/or RSC, shall oversee ionizing radiation safety; approve radioactive material usage; ensure activities involving radioactive materials are conducted in accordance with applicable requirements; and take prompt corrective measures to appropriately manage or control hazards.

4.14.3 Process Description

4.14.3.1 Centers with operations potentially exposing workers or the public to ionizing radiation from radioactive materials shall develop written procedures to identify and control those radiation exposures in accordance with this section and the appropriate paragraphs of section 4.13.

4. 14.3.2 Operations and activities shall include reasonable controls directed toward reducing exposure, preventing the spread of radiological contamination, and minimizing the generation of contaminated wastes and the release of effluents.

4.14.3.3 Personal dosimeters that require processing to determine the radiation dose and are used to comply with dose limits shall be processed and evaluated by a dosimeter processor holding current personal dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of NIST.

4.14.3.4 Activities involving radioactive materials shall be conducted in accordance with applicable NRC or NRC Agreement state issued licenses for radioactive materials.

4.14.3.5 All procurement, use, transfer, and disposal of radiation-generating equipment shall be coordinated with the designated radiation protection competent approval authority (e.g., LSO, RSO, RSC, etc.).

4.14.3.6 Irradiation facilities using nonmedical x-ray and sealed gamma-ray sources shall comply with ANSI/HPS N43.3.

4.14.3.7 The following criteria shall be met for operations involving radioactive materials:

a. Procurement, use, storage, transfer, and disposal of radioactive materials shall be pre-approved by the RSO or RSC;

b. Control of radioactive contamination shall be achieved by using engineering controls and worker performance to contain contamination at the source, reducing existing areas of contamination, and promptly decontaminating areas that become contaminated.

c. Contaminated surfaces shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable contamination levels.

d. Contamination levels caused by ongoing work shall be monitored and maintained ALARA.

e. Contamination found in unrestricted areas should be immediately decontaminated to background levels. When it is not possible to get to background levels, the contamination levels listed in the governing NRC or Agreement State issued specific materials license documents shall not be exceeded. The Surface Contamination Values listed in Appendix D to 10 CFR 835 shall apply where contamination limits are not specified under NRC or Agreement State issued specific materials license documents.

f. When equipment or facilities that are potentially contaminated are to be released for unrestricted use, the requirements in paragraph e above provide the maximum acceptable residual levels. To the extent practicable, it is appropriate to decontaminate to below these levels. Surface contamination surveys should be conducted for both removable and fixed contamination before these facilities or equipment are released from restricted to unrestricted use, to ensure that they meet these limits.

g. A standardized method for smear testing of a relatively uniform area should be used to aid in comparing contamination at different times and places. A smear taken from an area of about 100 cm2 is acceptable to indicate levels of removable contamination.

4.14.3.8 To accomplish NASA's objective of maintaining individual doses below regulatory limits and ALARA, Centers shall establish administrative control levels below the regulatory dose limits.

4.14.3.9 Smoking, eating, and drinking are prohibited in restricted areas.

4.15 Ionizing Radiation-Generating Equipment

4.15.1 General

4.15.1.1 Radiation protection requirements shall be instituted for electronic radiation-generating equipment (e.g., x-ray machine, particle beams) and equipment that produces radiation incidental to its operation (e.g., electron microscope) at all NASA Centers.

4.15.1.2 All procurement, use, transfer, and disposal of radiation-generating equipment shall be coordinated with the designated radiation protection competent approval authority (e.g., RSO, RSC, etc.);

NOTE: Radiation-generating equipment is defined as devices which produce ionizing radiation without the use of radioactive material.

4.15.2 Responsibilities

4.15.2.1 The OCHMO shall provide guidance and advice to NASA Centers on ionizing radiation-generating equipment.

4.15.2.2 The Director of Health and Medical Systems shall ensure Center ionizing radiation-generating equipment policy and programs are assessed for efficacy through regular, periodic reviews.

4.15.2.3 Center Senior Management shall designate, in writing, competent and qualified personnel to administer a program for control and accountability of radiation-generating equipment.

4.15.2.4 Center RSOs and/or RSC shall oversee ionizing radiation safety; approve radiation generating equipment usage; ensure activities involving radiation generating equipment are conducted in accordance with applicable OSHA, state, and Agency requirements; and take prompt corrective measures to appropriately manage or control hazards.

4.15.3 Process Description

4.15.3.1 Centers with operations potentially exposing workers or the public to ionizing radiation from radiation-generating equipment shall develop written policies and procedures to identify and control those exposures in accordance with this section.

4.15.3.2 To accomplish NASA's objective of maintaining individual doses below regulatory limits and ALARA, Centers shall establish administrative control levels below the regulatory dose limits.

4.15.3.3 Personal dosimeters that require processing to determine the radiation dose, and which are used to comply with the dose limits, shall be processed and evaluated by a dosimetry processor holding current personal dosimetry accreditation from the NVLAP of the NIST.

4.15.3.4 The following criteria shall be met for all radiation-generating equipment:

a. Procurement, use, transfer, and disposal shall be pre-approved by the RSO or RSC;

b. Design and operation of irradiation facilities using non-medical x-ray shall comply with ANSI/HPS N43.3-2008;

c. Design and operation of installations using x-ray diffraction and fluorescence analysis equipment shall comply with the requirements contained in ANSI Standard N43.2-2001;

d. Certified cabinet x-ray systems shall be surveyed at intervals not to exceed 12 months to ensure conformance with Federal performance standards;

e. Medical x-ray systems shall be surveyed at intervals not to exceed 24 months to ensure conformance with Federal performance standards;

f. Diagnostic x-ray systems shall be operated in accordance with a 21 CFR 1000.55 conforming quality assurance program; and

g. Special considerations for particle accelerator operations shall include the presence of extremely high dose rates, high energy and heavy particles, activation products, and detection and monitoring difficulties associated with pulsed or high energy radiation.

4.16 Laser and Non-laser Optical Radiation

4.16.1 General

4.16.1.1 Radiation protection requirements shall be instituted for laser and non-laser optical radiation-generating equipment (i.e., ultraviolet, infrared, and high-intensity lights) at all NASA Centers.

4.16.1.2 All procurement, use, transfer, and disposal of hazardous nonionizing radiation-generating equipment shall

be coordinated with the designated radiation protection competent approval authority (e.g., LSO, RSO, RSC, etc.).

4.16.2 Responsibilities

4.16.2.1 The OCHMO shall provide guidance and advice to NASA Centers on laser and non-laser optical radiation.

4.16.2.2 The Director of Health and Medical Systems shall ensure Center laser and non-laser optical radiation programs are assessed for efficacy through regular, periodic reviews.

4.16.2.3 OCHMO shall resolve conflicts between Centers and states, the U.S. Military, and other Federal agencies.

4.16.2.4 Centers implement protective requirements for use of lasers and sources of hazardous non-laser optical radiation (i.e., ultraviolet, infrared, and high-intensity lights).

4.16.2.5 Centers operating lasers in unrestricted air space should coordinate outdoor laser mission details with, and request a Letter of Determination from, the Federal Aviation Administration (FAA) at least 30 days prior to propagation of the related mission's laser beam through the U.S. navigable airspace.

4.16.2.6 Centers operating lasers in restricted air space shall coordinate with, and obtain permission from, the controlling authority (e.g., military base command).

4.16.2.7 All outdoor laser missions shall meet the applicable requirements of ANSI Z-136.6, SAE Aerospace Standard (AS) 6029A, and the NASA Laser Safety Review Board (LSRB), including its Charter (Appendix F), and associated policies and procedures.

4.16.2.8 Except for lasers used in research, only laser products that comply with Federal Laser Product Performance Standards shall be procured or manufactured; unless a specific exemption is obtained from the FDA.

4.16.2.9 Quality assurance verification of laser output shall be obtained for all commercial off-the-shelf (COTS) lasers used outdoors following modifications with the potential to alter beam output. QA verification should include applicable laser parameters (e.g., wavelength, radiant power, energy, pulse width, pulse repetition frequency, and beam divergence).

4.16.2.10 For DoD-funded outdoor laser operations, Centers shall coordinate outdoor laser mission details with, and obtain permission from, the U.S. Strategic Command prior to propagation of the related mission's laser beam above the horizon in accordance with the

28 February 2012 AIR FORCE MEMORANDUM FOR JFCC Space/J9, entitled Satellite Protection Guidance for the Laser Clearinghouse (Appendix G).

4.16.2.11 Centers shall coordinate exemptions for Federal Performance Standards with the FDA.

4.16.2.12 Center Senior Management shall designate in writing, competent and qualified personnel to administer a program for control and accountability of laser and non-laser optical radiation sources, which shall:

a. Oversee laser and non-laser optical radiation source safety;

b. Approve laser and non-laser optical radiation source usage, including use locations;

c. Ensure activities involving laser and non-laser optical radiation sources are conducted in accordance with Federal, state, and Agency requirements; and

d. Take prompt corrective measures to eliminate hazards.

4.16.3 Process Description

4.16.3.1 Centers with operations potentially exposing workers or the public to laser or hazardous non-laser optical radiation shall develop written procedures to identify and control radiation exposures in accordance with this section and applicable paragraphs of section 4.13. Requirements shall be based on accessible emission levels and ancillary non-beam hazards.

4.16.3.2 Personnel working with class 3b and 4 lasers and hazardous sources of non-laser optical radiation shall be appropriately trained in safe work practices for controlling or mitigating personal exposures. Training shall be provided to personnel working with or potentially exposed to Class 1M, Class 2, Class 2M, or Class 3R laser radiation if planned use could potentially exceed Maximum Permissible Exposure Limits (MPELs). The level of training shall be commensurate with the degree of potential laser hazards, both from the laser radiation and non-beam hazards.

4.16.3.3 Class 3b and 4 lasers and laser systems shall require a hazard assessment and approval by the LSO and/or LSC whether indoors or outdoors.

4.16.3.4 Hazards to personnel shall be eliminated, or procedures shall be developed and equipment provided to control those hazards that cannot be eliminated by engineering design prior to source approval.

4.16.3.5 Protective measures shall be employed to ensure that personnel are not exposed to laser and non-laser optical radiation in excess of the MPE limits.

4.16.3.6 Class 1 laser systems containing embedded lasers shall be controlled according to the classification of the embedded laser when engineering controls (e.g., enclosures, interlocks) are bypassed.

4.16.3.7 The LSRB shall be the final review body for all NASA-sponsored outdoor laser operations, including laser safety launch approval for use of lasers in space, ground-based and airborne laser missions.

4.16.3.8 The LSRB shall review proposed use of all outdoor lasers under NASA purview to ensure compliance with applicable regulatory requirements and adherence to exposure limits.

4.16.3.9 The LSRB shall make recommendations to the Agency on matters related to outdoor laser use and review the use of all outdoor lasers under NASA's purview.

4.16.3.10 All outdoor laser operations shall meet the following requirements:

a. Laser safety packages shall be submitted to LSRB in accordance with the LSRB Charter, and its associated policies and procedures;

b. Have LSO and/or LSC approval prior to use;

c. Caution shall be exercised to prevent visual interference in FAA designated flight zones established around airports;

d. A comprehensive outdoor laser use assessment shall be documented in accordance with the LSRB Charter, and its associated policies and procedures;

e. To ensure against inadvertent laser emissions and to mitigate potential catastrophic events, approval of airborne laser operations shall rely on a combination of interlocks and high-speed shutdown systems, as deemed necessary by engineering analyses;

f. If software is used in conjunction with lasers, it shall require a software safety analysis per NPR 8715.3, NASA General Safety Program Requirements;

g. Centers shall advise the Agency Radiation Safety Manager of all outdoor laser coordination with the FAA, U.S. Strategic Command, and/or local military commands and shall copy the SEHO and the LSRB Chairperson on such correspondence, including requests for Letters of Determination from the FAA and all other coordination of matters arising from outdoor lasers.

h. Objections, verbal or written, to the use of specific outdoor lasers by the FAA or the U.S. Military, shall be honored until the LSRB reviews the complaint and authorizes continuation of operations.

4.16.3.11 Centers shall comply with the MPE limits for laser radiation specified in ANSI Z136.1 and the occupational exposure limits for non-laser optical radiation specified in *ACGIH Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices.*

4.17 Radio Frequency Electromagnetic Radiation

4.17.1 General

4.17.1.1 Radiation protection requirements shall be instituted for electromagnetic radiation-generating equipment at all NASA Centers.

4.17.1.2 All procurement, use, transfer, and disposal of hazardous electromagnetic radiation-generating equipment shall be coordinated with the designated radiation protection competent approval authority (e.g., LSO, RSO, RSC, etc.).

4.17.1.3 NASA Centers shall implement radiation protection requirements to prevent or control potential risks associated with exposure to electromagnetic fields from RF and microwave sources that operate in the frequency range of 3 kHz and 300 GHz, including, but not limited to, radar systems; spacecraft and vehicle telemetry and communications systems; Earth stations; microwave diathermy units; radio frequency generators; and Radio Frequency (RF) heat sealers.

> *NOTE: Hazards of electromagnetic radiation to ordinance are beyond the scope of this document. The OSMA maintains purview regarding electromagnetic radiation and its relationship to ordnance.*

4.17.2 Responsibilities

4.17.2.1 The OCHMO shall provide guidance and advice to NASA Centers on radio frequency electromagnetic radiation.

4.17.2.2 The Director of Health and Medical Systems shall ensure Center radio frequency electromagnetic radiation

policy and programs are assessed for efficacy through regular, periodic reviews.

4.17.2.3 Center Senior Management shall designate competent and qualified personnel to administer a program for control and accountability of RF and microwave radiation devices, whom shall:

a. Oversee RF and microwave safety;

b. Approve RF and microwave radiation equipment usage;

c. Ensure activities involving RF and microwave equipment are conducted in accordance with applicable OSHA, state, and NASA requirements; and

d. Take prompt corrective measures to eliminate hazards.

4.17.3 Process Description

4.17.3.1 Each Center with operations potentially exposing workers or the public to non-ionizing radiation above the applicable lower tier exposure limits from RF and microwave generating equipment shall develop written procedures to identify, document, and control those radiation exposures in accordance with Institute of Electrical and Electronics Engineers (IEEE) Standard C95.7.

4.17.3.2 Techniques and instrumentation for the measurement and computation of potentially hazardous RF radiation both in the near field and the far field of the RF or microwave source, including contact voltage and contact and induced currents, shall be in accordance with IEEE Standard C95.3.

4.17.3.3 All personnel with exposures likely to exceed the lower tier exposure limit for controlled environments shall be appropriately trained in safe work practices for controlling or mitigating personal exposures.

4.17.3.4 Exposures, of the general public and workers who do not have occupational duties requiring exposure to microwave and/or RF radiation, shall be kept below the upper tier exposure limit for uncontrolled areas as specified in IEEE C95.1.

4.17.3.5 Exposures of workers whose occupational duties require exposure to microwave and/or RF radiation above that allowed in uncontrolled areas shall be kept below the upper tier exposure limit allowed in controlled areas.

4.17.3.6 Training shall be provided to workers who have occupational duties that require exposure at IEEE C95.1 defined levels, which shall include the hazards of exposure; safe work practices; concepts of "time-averaged exposure;" and the methods to reduce, eliminate, or mitigate the hazards.

4.17.3.7 Workers shall be provided with specific information from surveys or computations described in 4.17.3.8 below, and guidance to prevent exposure greater than the upper tier exposure limit.

4.17.3.8 RF and microwave radiation source approvals shall be based on documented RF exposure assessments, which include direct measurements when practicable.

4.17.3.9 Operations and activities shall include reasonable controls directed toward reducing exposure. Such controls include engineering and administrative controls as well as the use of personal protective equipment, placement of appropriate RF safety signage, designation of restricted access areas, RF safety awareness training, and the use of personal RF monitors.

4.17.3.10 The beam height of RF and microwave transmitters shall be maintained at a level that does not intercept occupied facilities or structures, or personnel within the identified hazard distance.

4.17.3.11 Limits for maximum permissible exposure and induced and contact RF currents shall be derived in accordance with IEEE Standard C95.1.

4.17.3.12 Limits for lower frequency electromagnetic fields and static magnetic fields shall be in accordance with ACGIH *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*.

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